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Keeler et al.

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(54) **ILLUMINATED JEWELRY SYSTEM AND METHODS OF MAKING SAME**

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A44C 15/00 (2006.01)
A44C 25/00 (2006.01)

(52) **U.S. Cl.**
CPC ***A44C 15/0015*** (2013.01); *A44C 25/00* (2013.01)

(58) **Field of Classification Search**
CPC A44C 15/005; A44C 15/0015; A44C 15/0045
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,477,433	A *	12/1995	Ohlund	A44C 15/0015	362/104
6,233,971	B1 *	5/2001	Ohlund	A44C 15/0015	362/104
7,104,668	B1 *	9/2006	Lee	A44C 15/0015	362/103
7,441,917	B1 *	10/2008	Underdown	A44C 15/0015	362/103
2004/0196650	A1 *	10/2004	Phlippeau	A44C 17/006	362/103
2005/0002180	A1 *	1/2005	Kamara	A44C 15/0015	362/104
2005/0174800	A1 *	8/2005	Clegg	A44C 15/0015	362/571
2006/0262531	A1 *	11/2006	Schrimmer	A44C 15/0015	362/240
2006/0291210	A1 *	12/2006	Lee	A44C 15/0015	362/249.01
2008/0048609	A1 *	2/2008	Kuhlmann	H02J 7/0042	320/107
2009/0044566	A1 *	2/2009	Underdown	A44C 15/0015	63/3

(Continued)

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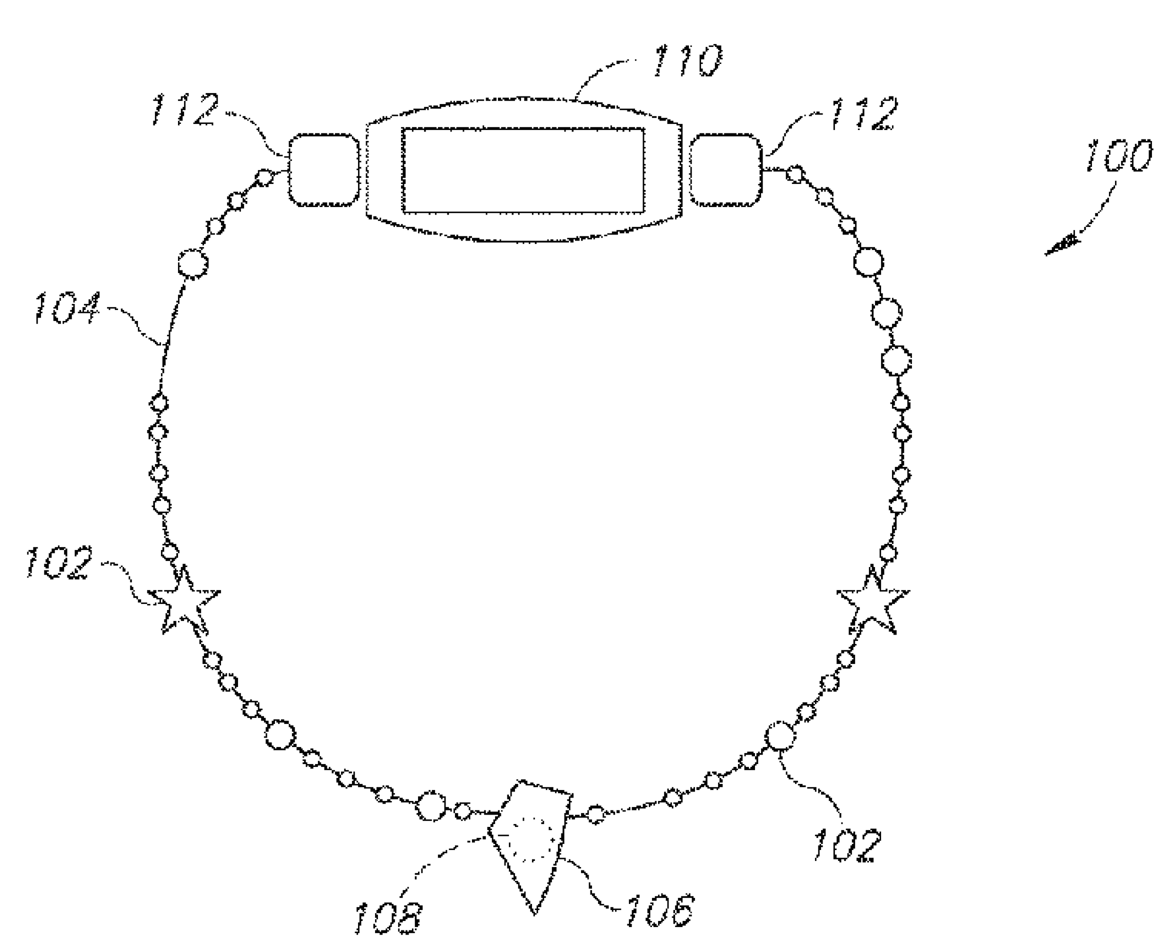
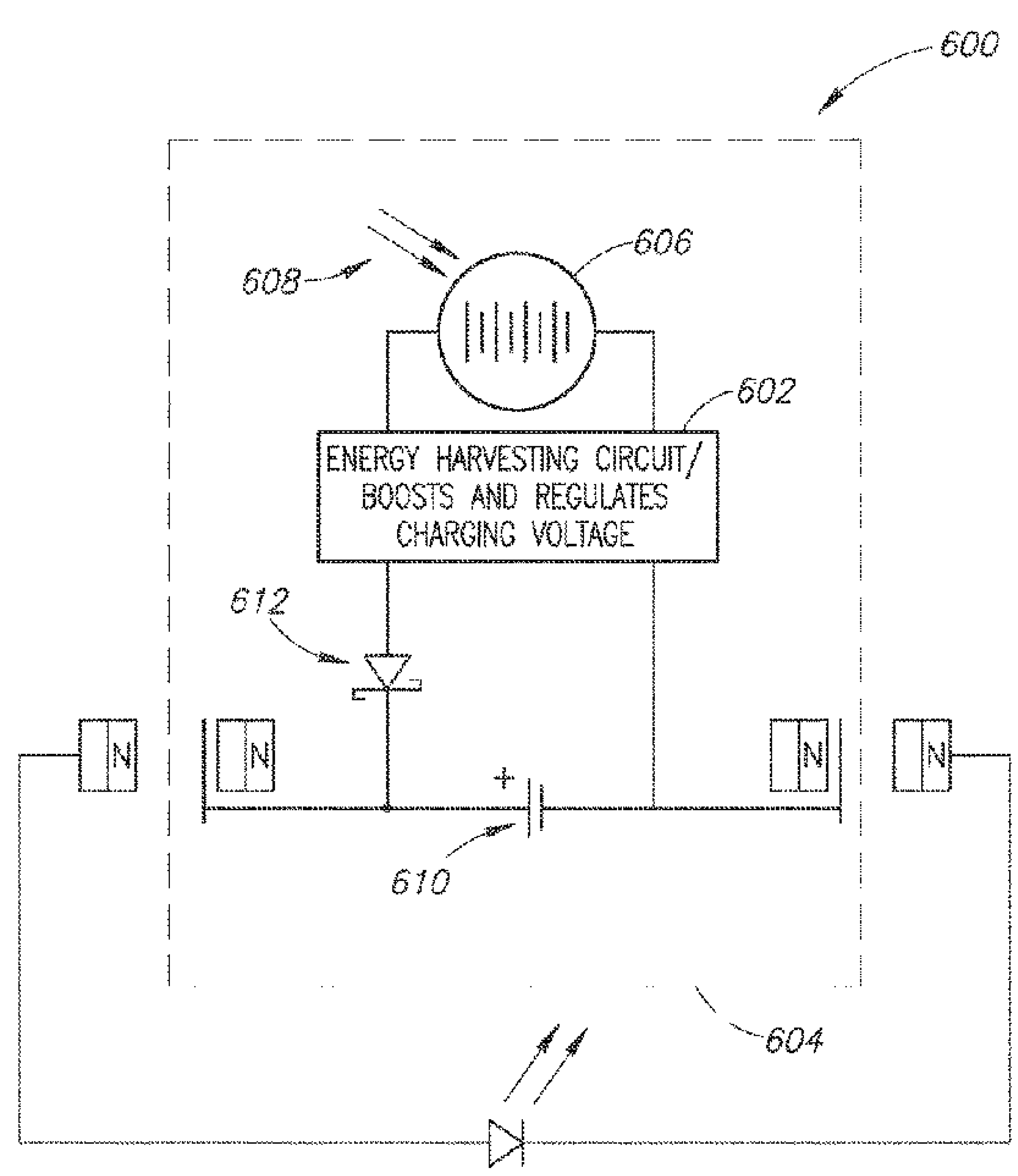
(57) **ABSTRACT**

The present invention generally relates to an illuminatable jewelry system having a jewelry element containing a controllable light source. By way of example, the jewelry element may be transparent or translucent. The jewelry may also have other types of decorative elements attached to a length of conductive jewelry wire. A power cell having a solar cell, an energy harvesting circuit and a rechargeable battery are in electronic communication with the light source. Magnetic connectors permit the illuminatable jewelry system to be worn and operate to complete an electrical circuit between the power cell and the light source.

8 Claims, 6 Drawing Sheets





(56) **References Cited**

U.S. PATENT DOCUMENTS

2012/0324947	A1*	12/2012	Opperman	A44C 5/2057 63/3.1
2014/0230487	A1*	8/2014	Vasguez	A44C 15/0015 63/1.11
2014/0338397	A1*	11/2014	Andreini, III	A44C 15/005 63/1.14
2015/0164188	A1*	6/2015	Gelfand	A44C 15/0015 63/1.13

* cited by examiner

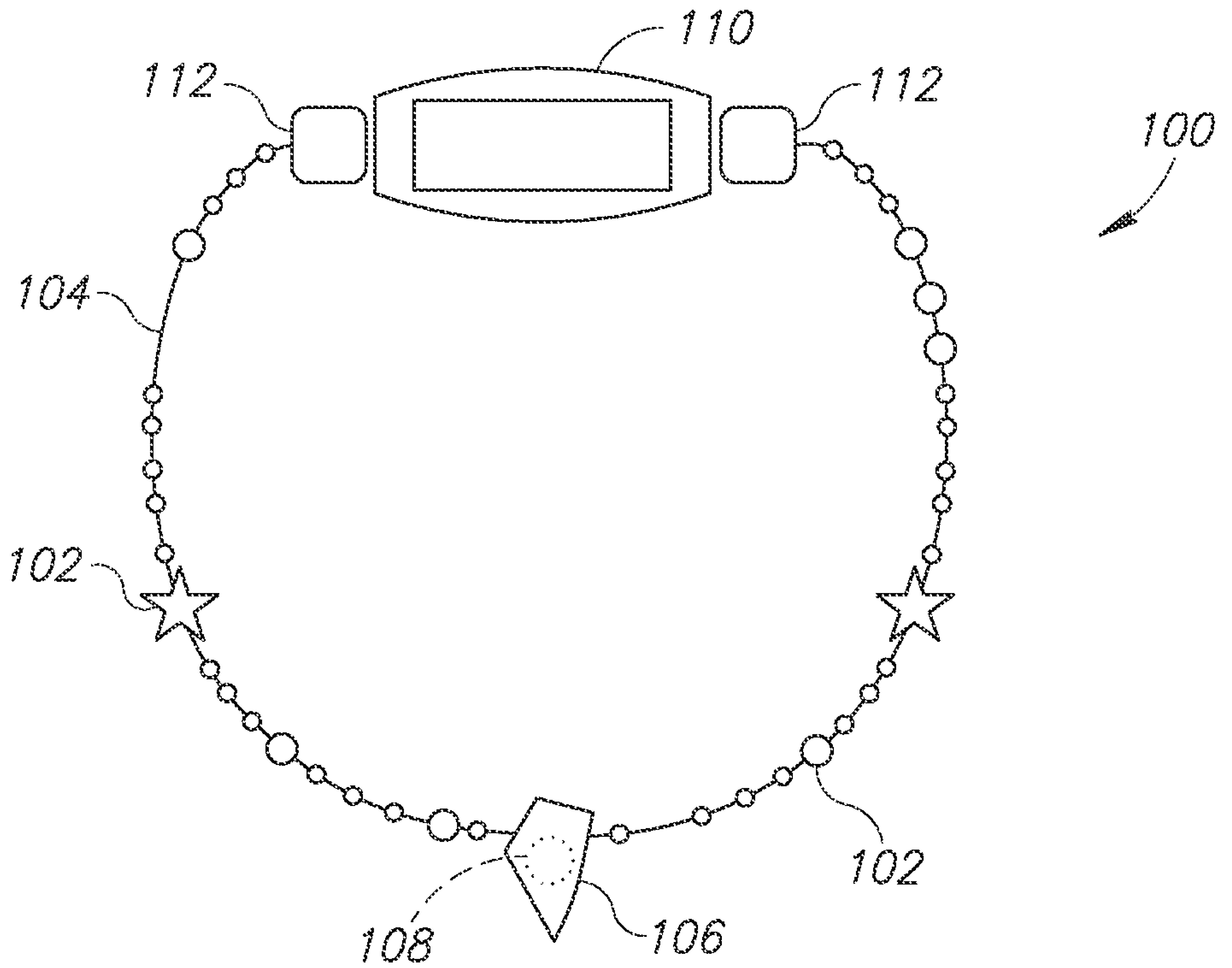


FIG.1A

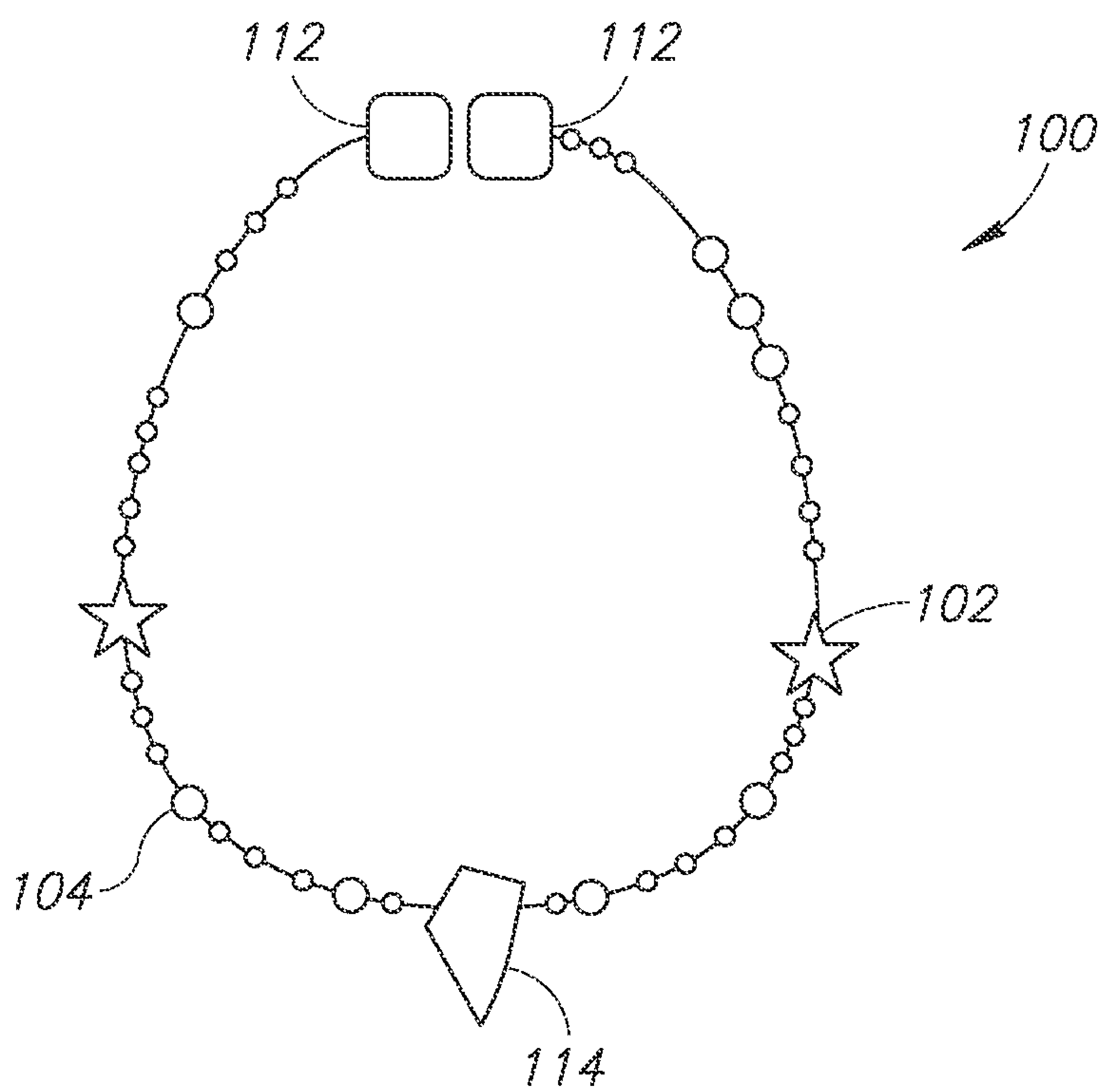


FIG.1B

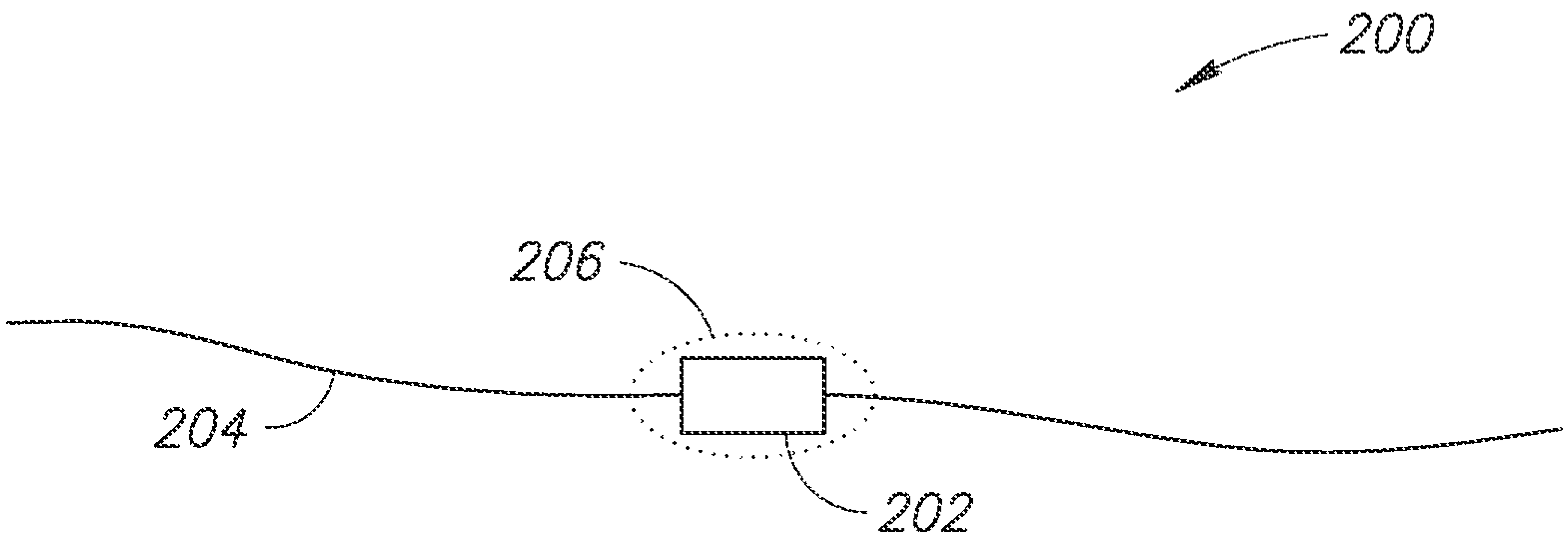


FIG.2

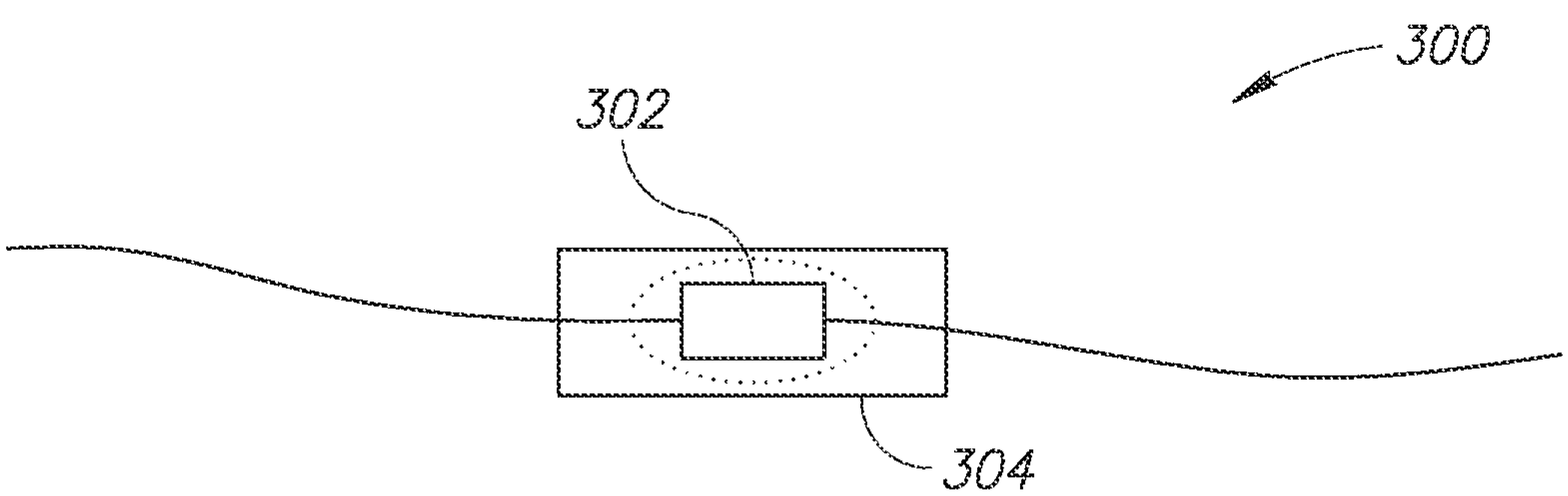


FIG.3

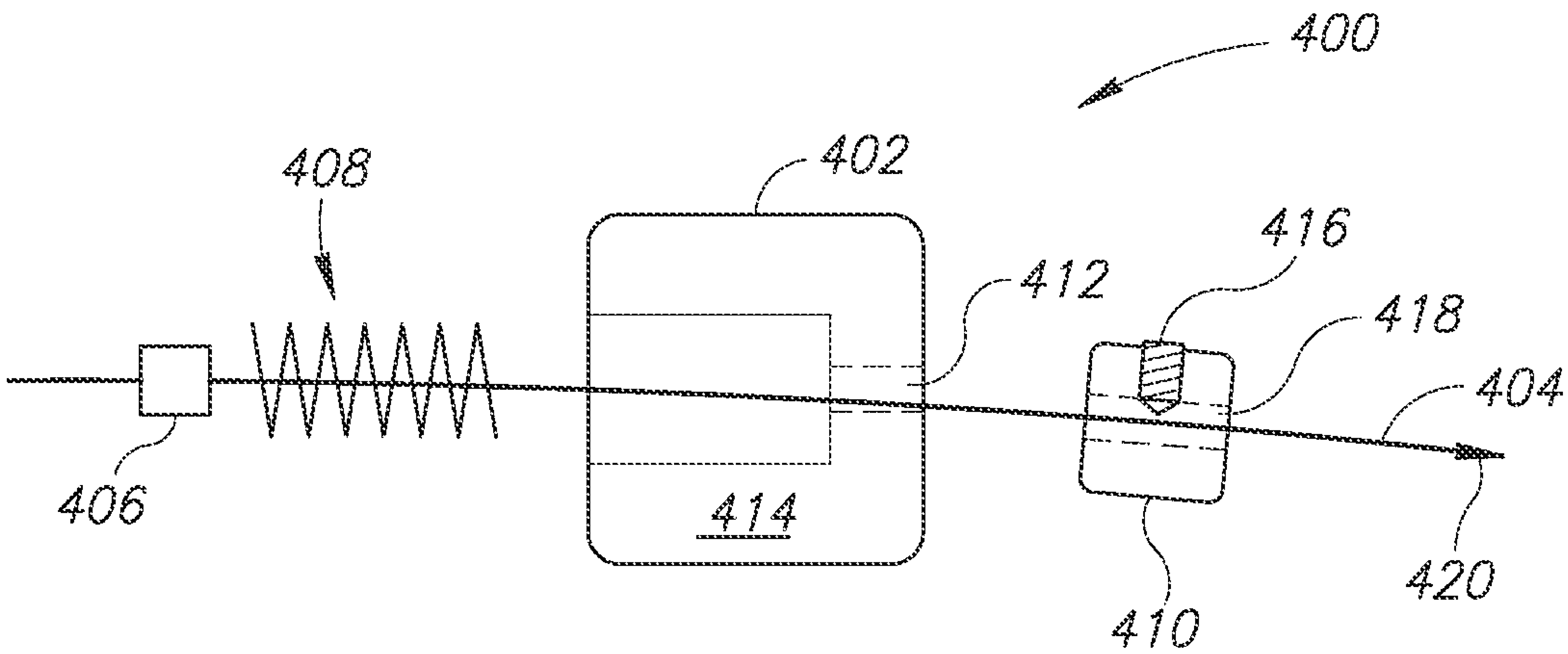

400
408
402
416
412
418
404
406
414
420
410

FIG.4A

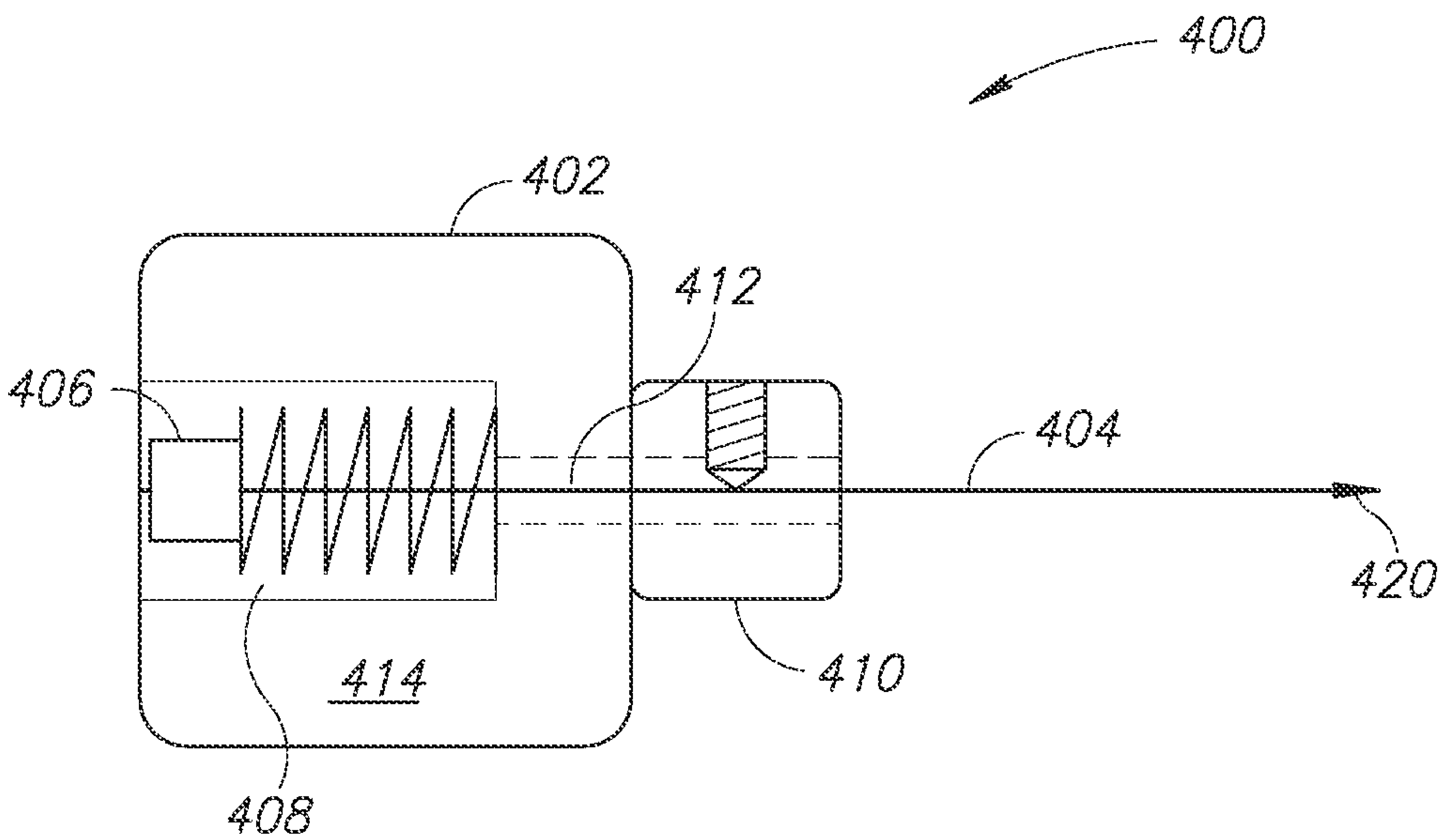

400
402
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FIG.4B

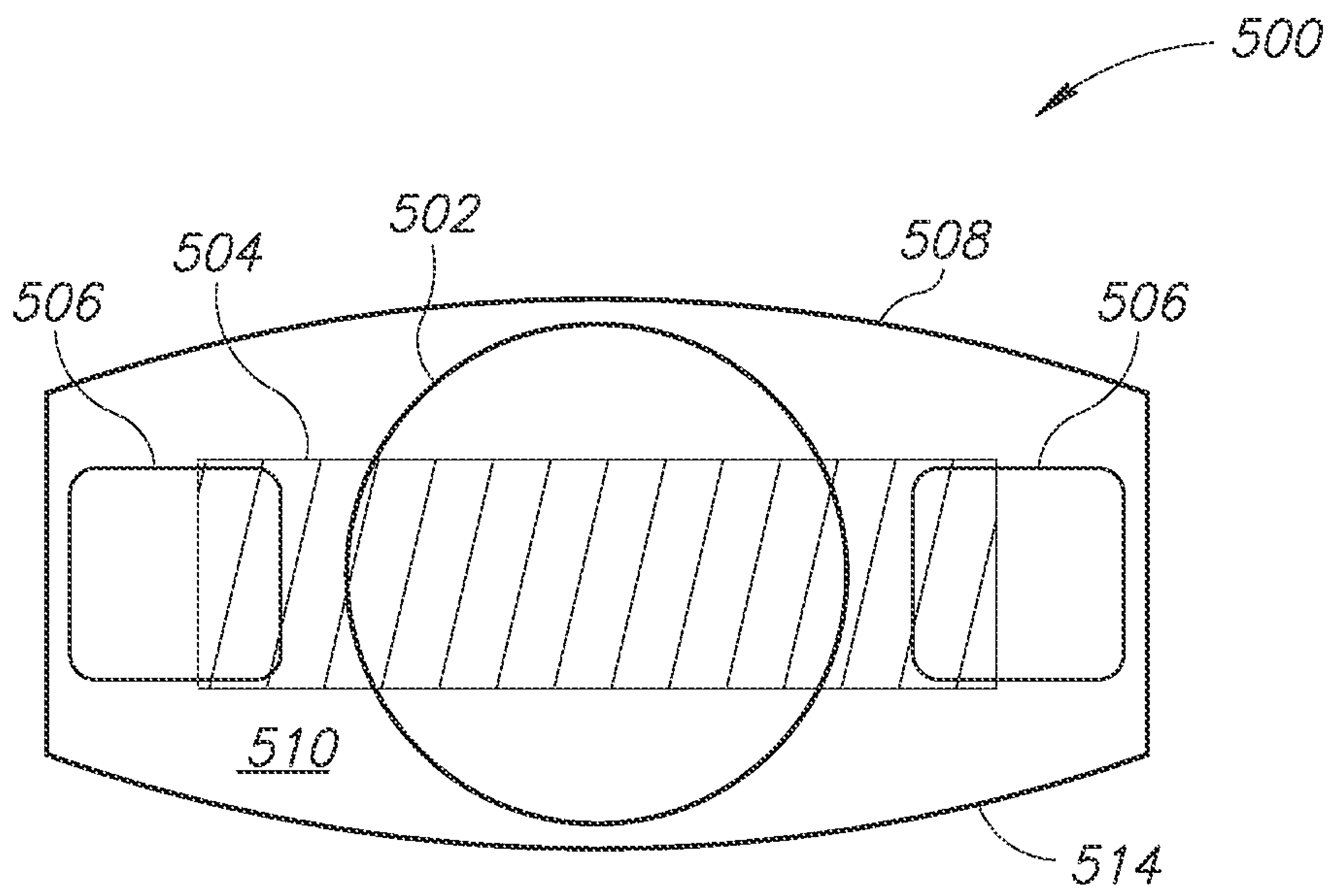

FIG.5A

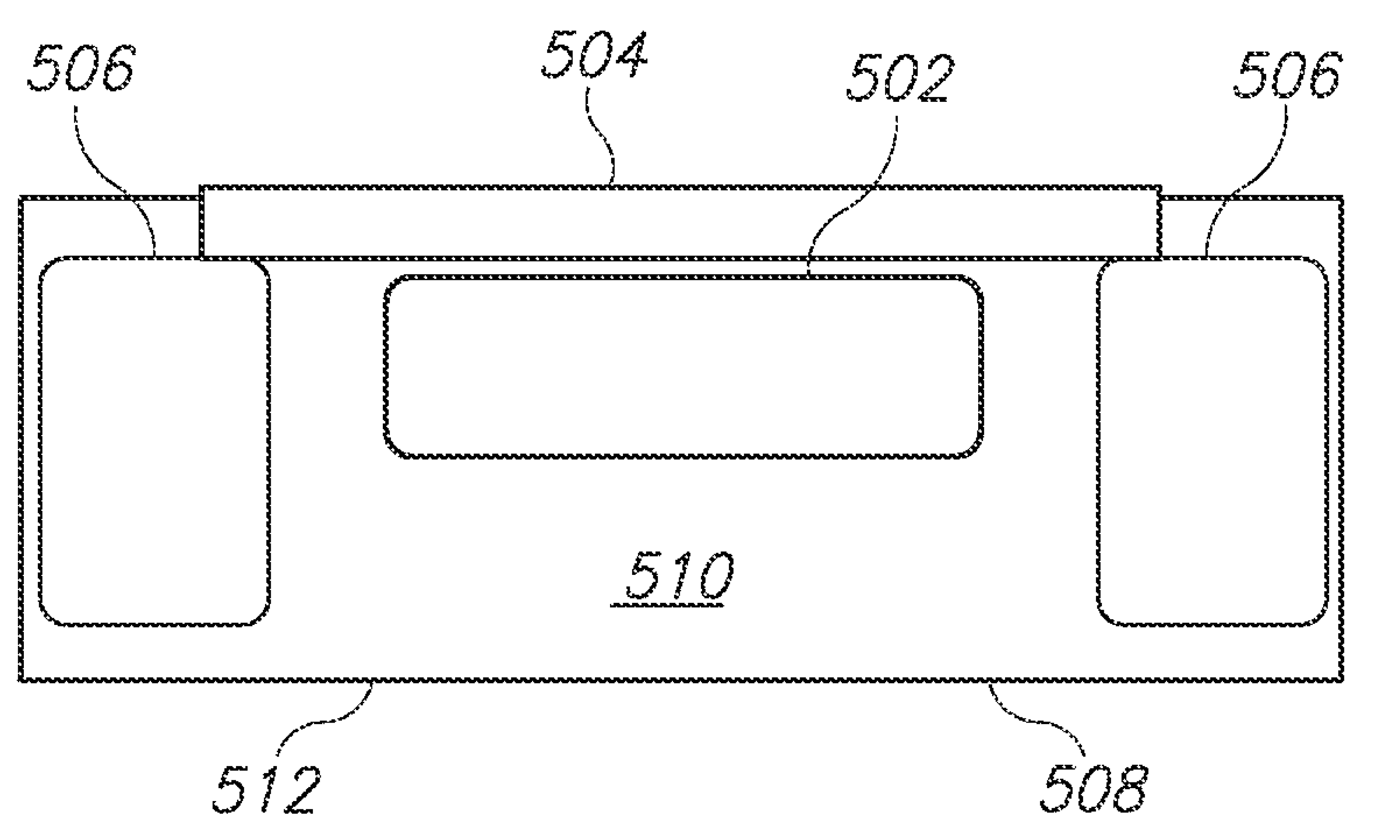

FIG.5B

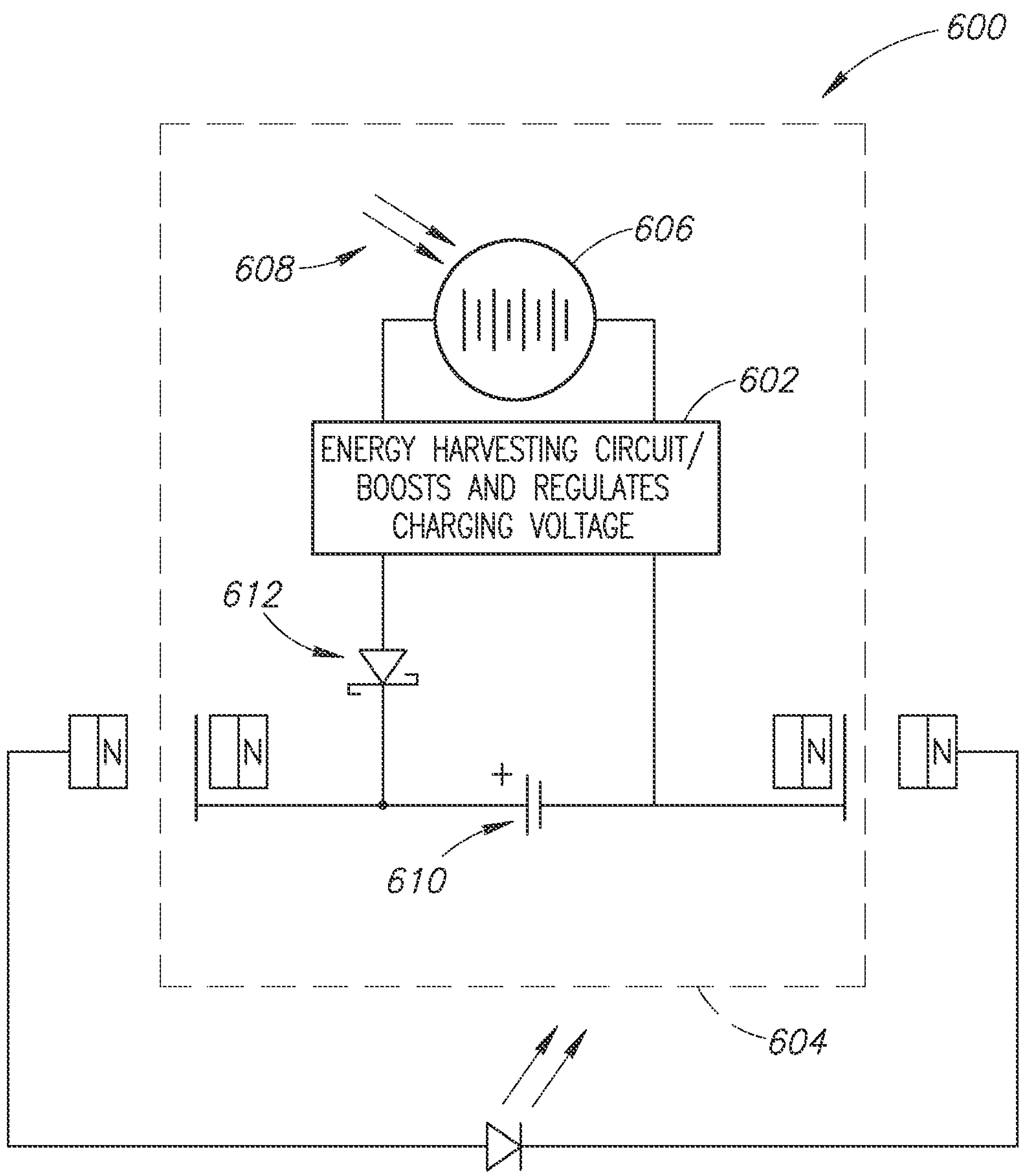
600
606
608
602
ENERGY HARVESTING CIRCUIT/
BOOSTS AND REGULATES
CHARGING VOLTAGE
612
N
N
N
N
+
610
604

FIG.6

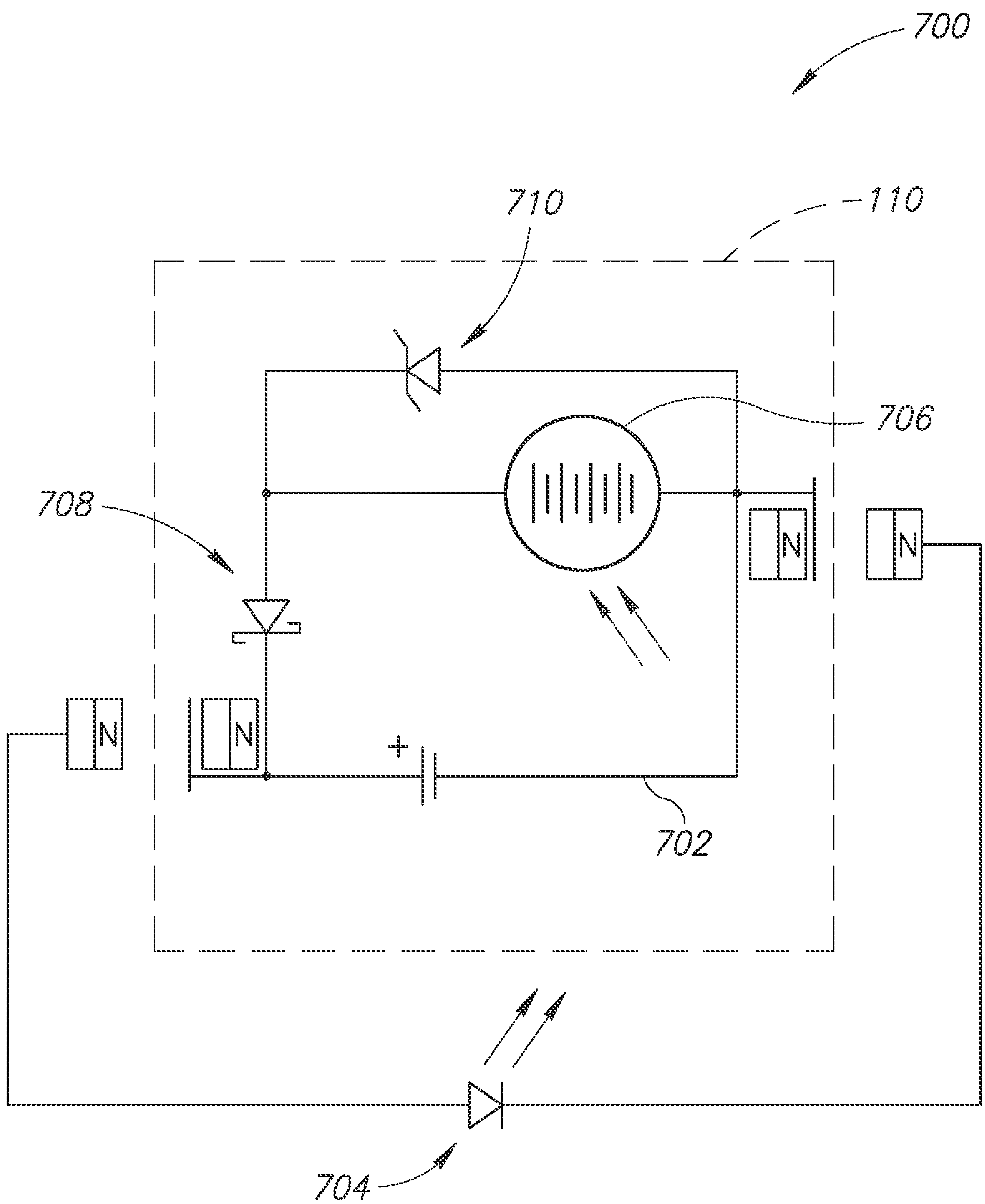

FIG.7

ILLUMINATED JEWELRY SYSTEM AND METHODS OF MAKING SAME

PRIORITY CLAIM

The present application claims the benefit of the filing date of U.S. Provisional Patent Application No. 62/033,994, and wherein its subject matter is incorporated by reference herein in its entirety.

FIELD OF THE INVENTION

The present invention generally relates to illuminated jewelry systems or jewelry systems that may be selectively illuminated (i.e., illuminatable jewelry) and methods for making the same. More specifically, the assembly of these jewelry systems may permit an end user to customize lighting elements (e.g., light emitting diodes (LEDs) into a wide variety of jewelry systems, which will be described in more detail below.

SUMMARY

The present invention generally relates to a system for illuminating transparent jewelry elements such as, but not limited to, glass beads, clear acrylic elements or translucent stones that may be part of a larger piece of jewelry such as a bracelet or a necklace. Transparent and translucent jewelry elements are broadly referred to as illuminatable jewelry elements herein. The jewelry system may include a small light source such as, but not limited to, a light emitting diode (LED) attached to stringing material, a power source and a connector designed to enforce polarity requirements for the illuminatable jewelry elements.

In one aspect of the present invention, an illuminatable jewelry system includes a length of jewelry stringing wire; a first magnetic connector coupled to a first end of the wire; a second magnetic connector coupled to a second end of the wire; a jewelry element made from a material that permits visible light to travel through a thickness of jewelry element; a light source located in the jewelry element; and a power cell coupled between the first and second magnetic connectors, the power cell in electronic communication with the light source to selectively modulate the visible light emanating from the light source.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings, identical reference numbers identify similar elements or acts. The sizes and relative positions of elements in the drawings may not be necessarily drawn to scale. For example, the shapes of various elements and angles may not be drawn to scale, and some of these elements may be arbitrarily enlarged or positioned to improve drawing legibility. Preferred and alternative embodiments of the present invention are described in detail below with reference to the following drawings:

FIG. **1**A is a front plan view of an illuminating jewelry system with a power cell according to an embodiment of the present invention;

FIG. **1**B is a front plan view of an illuminating jewelry system without a power cell according to an embodiment of the present invention;

FIG. **2** is a partial, schematic view showing an encapsulated light source according to another embodiment of the present invention;

FIG. **3** is a partial, schematic view showing a light source within a capillary tube according to another embodiment of the present invention;

FIG. **4**A is a pre-assembled schematic view of a magnetic connector assembly according to another embodiment of the present invention;

FIG. **4**B is an assembled schematic view of a magnetic connector assembly according to another embodiment of the present invention;

FIG. **5**A is a top plan view of a power cell assembly according to an embodiment of the present invention;

FIG. **5**B is a side elevational view of the power cell assembly of FIG. **5**A;

FIG. **6** is a schematic diagram for an illuminating jewelry system having an energy harvesting circuit according to an embodiment of the present invention; and

FIG. **7** is a schematic diagram for an illuminating jewelry system according to an embodiment of the present invention.

DETAILED DESCRIPTION

In the following description, certain specific details are set forth in order to provide a thorough understanding of various embodiments of the invention. However, one skilled in the art will understand that the invention may be practiced without these details. In other instances, well-known structures associated with jewelry, to include assemblies, subassemblies and detail components thereof, and methods of using, assembling and installing any of the above may not have been shown or described in detail to avoid unnecessarily obscuring descriptions or other aspects of the embodiments of the invention. For purposes of the description and claims herein, the term "jewelry" should be broadly interpreted to mean any type of gem, rock, precious metal, trinket medallion, brooch, pin pendant, as well as any physical element that may be considered to have aesthetic beauty or and/or other aesthetic qualities.

FIG. **1**A shows a jewelry system **100** having decorative elements **102** attached to stringing material **104** according to an embodiment of the present invention. The decorative elements **102** may take the form of beads, gems, stones, etc. that may be part of a larger piece of jewelry such as a bracelet or a necklace. In addition, the jewelry system **100** includes an illuminatable element **106** made from a material that allows light to penetrate through a wall thickness or total thickness of the illuminatable element **106**, in which the latter further includes a light source **108** (not shown) such as, but not limited to a light emitting diode (LED). A power cell **110**, such as a solar cell, may be located between magnetic clasps **112** (i.e., magnetic connectors). The power cell **110** may take the form of a solar powered component or battery that stores and delivers electrical current. By way of example, the solar powered components may take the form of a self-contained solar rechargeable battery. In one embodiment, the power cell **110** is completely enclosed, and has no moving, removable or serviceable parts. The battery within the power cell **110** may be re-charged using a small solar panel. The magnetic clasps **112** are configured to enforce the polarity requirements for activating the illuminatable element **106**.

The illuminatable elements **106** may take the form of glass beads, clear acrylic elements, translucent stones, or any other type of material that allows some amount of visible light penetration through its thickness. The decorative elements **102** may also be transparent or translucent, and likewise the light source **108** may be small enough to thread through and into the decorative elements such as, but not limited to, stones or beads. Overall, the various system components are compatible with a variety of other jewelry components both in function and in aesthetics.

For example in one embodiment, the stringing material **104** may take the form of an industry standard nylon-coated multi-strand silver, copper or brass wire (also referred to as beading wire) designed for beaded jewelry. The stringing material **104** operates as a structural element and as a conductive electrical element to complete the electric circuit between the power cell **110** and the light source **108**. The nylon coating prevents accidental electrical shorts. Electrical connections may be secured with aesthetically compatible jewelry crimps.

FIG. **1**B shows the jewelry system **100** with the power cell **108** removed for recharging or merely because the wearer does not want the illuminatable jewelry element **106** to be lit for whatever reason. In one embodiment, the power cell **110** may be recharged by removing the power cell **110** while leaving behind the unlit jewelry element **114**. Further as shown in FIG. **1**A, the power cell **110** may be connected with two conductive/magnetic connections **112**, one on each side of the power cell **110**.

The jewelry system **100** may be provided to the end user fully assembled and ready to accept beads. The end user may thread the light source **108** into a focal element such as a transparent or translucent bead or stone.

FIG. **2** shows an embodiment of an LED **200** assembly in which an LED **202** is coupled to jewelers beading wire **204**. The LED **202** is encapsulated within a housing **206** made of epoxy or cyanoacrylate. By way of example, the LED **202** may be sized to measure less than one millimeter (mm) in width. The wire **204** should preferably be compatible with both standard soldering practices and be commonly used in jewelry making (sterling silver, copper, brass, etc.). The soldered connections may be insulated and mechanically reinforced with cyanoacrylate or clear epoxy. The solder connections and the housing **206** may not fully support the weight and mechanical stresses of a piece of jewelry. Additional mechanical strength may be obtained by adhering or otherwise fastening the LED **202** and some of the surrounding wire **204** into or onto the bead or stone to be illuminated.

FIG. **3** shows an LED assembly **300** having an LED **302** secured in a glass capillary tube **304**. In one embodiment, the LED **302** is adhered into a reinforced, frosted glass capillary tube **304**. In this embodiment, additional mechanical reinforcement may not be necessary. The glass capillary tube **304** may be supplied with a texture or a color that modifies and/or enhances various properties of the visible light emanating from the LED **302**.

FIGS. **4**A and **4**B show a magnetic connector assembly **400** before and after a magnetic connector **402** is crimped or secured to a section of electronically conductive jewelers beading wire **404** (hereinafter "conductive wire") according to an embodiment of the present invention. The magnetic connector assembly **400** includes the magnetic connector **402**, a jewelry crimp **406**, a spring **408** and a screw-type crimp **410**.

In one embodiment, the end user attaches each magnetic connector **402** to the two separate sections of the jewelers beading wire **404** after the wire has been strung with beads or other decorative elements.

Magnets are now commonly used as clasps within the jewelry industry. In the illustrated embodiment, the magnetic connector **402** includes a small hole **412** for threading the conductive wire **404**, and a larger hollow region **414** to house and secure the jewelry crimp **406**. Preferably, the magnetic connector **402** is coated with a conductive silver finish, but it is appreciated the coating or finish may be made of another material or combination of materials such as, but not limited to, gold or copper. The jewelry crimp **406** may take the form of a crushable-tube crimp (hereinafter referred to as the "tube crimp"). The end user deforms and crushes tube crimp **406** around the conductive wire **404**. In the jewelry industry, such a tube crimp **406** typically functions as a mechanical stop. In this illustrated embodiment, the tube crimp **406** pierces a nylon coating protecting the conductive wire **404** to make an electrical connection.

The screw-type crimp **410** takes the form of a re-useable, non-deformable tube with a small set screw **416** perpendicular to a central channel **418**. As shown in the illustrated embodiments of FIGS. **4**A and **4**B, the end user threads the wire **404** through the screw-type crimp **410** without tightening the screw **416**, through the magnet **402**, and through a small spring **408**, then through the jewelry crimp **406** To finish assembling the magnet connector assembly **400**, the end user pulls back on the wire **404** in direction of the arrow **420** and then tightens the set screw **416**. Torqueing the set screw **416** pierces the nylon coating or any other type of non-conductive coating on the wire **404** to make the electrical connection while fixing the magnet **402** to the wire **404**. The coiled spring **408** insures that electrical contact is present between the wire **404** and the conductive surface of the magnet **402**, via one or both of the crimps **406**, **410**.

FIGS. **5**A and **5**B show a magnetic power cell **500** according to an embodiment of the present invention. In one embodiment, the magnetic power cell **500** is provided to the end user fully assembled and ready to insert between the two magnetic connectors **112** (see FIG. **1**A). The power cell **500** includes a rechargeable battery **502**, a solar cell **504**, two magnets **506** coupled to each end of the solar cell **504**, and a decorative housing **508**. In one embodiment, the housing **508** may be filled or at least partially filled with an epoxy resin material **510** to add structural stability, and to secure and insulate the various components. The housing **508** may take the form of a three-sided housing with a flat bottom panel **512** (see FIG. **5**A) and two curved side panels **514** (see FIG. **5**B). The housing **508** may be made from a thin gauge decorative material such as, but not limited to, silver, copper, brass, or plastic. An active area of the solar cell **504** may be exposed to an ambient environment.

FIG. **6** shows a schematic diagram **600** that includes an energy harvesting circuit **602** within a power cell **604** configured to be electrically efficient, and use one or more energy harvesting technologies. A solar cell **606** forms a portion of the energy harvesting circuit **602** and may include several cells in series for the energy harvesting circuit to work efficiently. By way of example, when the solar cell **606** is exposed to light **608** then a voltage is generated across its terminals. Energy from the solar cell **606** may be transformed into an appropriate voltage for charging a battery **610** via the energy harvesting circuit **602**. The battery **610** charges when the battery's potential falls below the charging voltage of the energy harvesting circuit **602**. In the illustrated embodiment, a diode **612** such as, but not limited to a Schottkey diode, is utilized to prevent the possibility of a backwards discharge of the battery **610**. The illustrated configuration allows current to flow from the solar cell **606** into the battery **610** with minimal voltage losses (potential drop across the diode **612**) while preventing current flow from the battery **610** back into the energy harvesting circuit **602**.

Rechargeable batteries typically have limits on their input charging voltage. Thus, the energy harvesting circuit **602** may operate to limit the charging voltage to prevent damage to the battery **610**. The energy harvesting circuit **602** may take the form of a multi-terminal integrated circuit and several sub-components such as, but not limited to a small, simple six-pin integrated circuit made by SEIKO®.

FIG. **7** shows a schematic circuit **700** for the power cell **110** (FIG. **1**A) according to another embodiment of the present invention. By way of example, the circuit **700** within the power cell **110** is designed to be electrically efficient, and therefore relies on carefully matched components as opposed to 'smart' charging circuits which use power to drive logic functions. A battery **702** is selected such that a single cell has a high enough voltage to drive the light emitting diode (LED) **704**. In addition, the internal resistance of the battery **702** should be such that the current flow through the LED **704** is within a safe operating tolerance. In other words, the battery **702** is sized to match the operational parameters of the LED **704**. Using this method reduces the number of external electrical components within the housing and minimizes resistive losses.

The solar cell **706** preferably generates sufficient voltage for charging the battery **702**. By way of example, the solar cell **706** may include several cells in series. Further, the properties of the solar cell **706** are matched to meet the charging requirements of the battery **702**.

When the solar cell **706** is exposed to light a voltage is generated across its terminals. When this voltage exceeds a predetermined threshold then the battery **702** will charge. If the voltage across the battery **702** is greater than the voltage across the solar cell **706** then the battery **702** may discharge through the solar cell **706**. To prevent this backwards or reverse discharge, the solar cell **706** is connected to the battery **702** through a Schottkey diode **708**, which allows current to flow from the solar cell **706** into the battery **702** with minimal voltage losses (potential drop across the diode) while preventing current flow from the battery **702** back into the solar cell **706**.

Rechargeable batteries have limits on the input charging voltage. A Zener diode **710** may be used to insure that the voltage generated by the solar cell **706** does not exceed the recommended charging voltage. The reverse breakdown voltage of the Zener diode **710** should preferably be matched to the recommended charging voltage of the battery **702**. Using a single-cell battery **702**, a small solar cell **706**, and two diodes **708**, **710**, all with carefully selected properties, preferably provides the minimal number of components to make a safe solar-rechargeable power source.

Referring to FIG. **7**, the LED **704** illuminates when the negative and positive terminals of the battery **702** make contact with the cathode (negative) and anode (positive) sides of the LED **704**, respectively. Rather than require the end user to identify the negative side of the magnetic connector **710** and cathode side of the LED **704**, the magnet polarities of both the magnetic connector **710** may be oriented such that the cathode side of the LED **704** will ONLY attach to the negative electrical contact (and the anode side of the LED **704** makes contact with the positive electrical contact). The polarities of the magnets are such that the LED connectors will enforce the requirements for positive current flow through the LED.

It may be desirable to modulate the light intensity as a function of time. By way of example the power cell circuit may be configured such that the LED flashes periodically, dims or changes color. To achieve different visual effects the end user may incorporate or exchange differently configured power cells.

Modifying circuits may also be introduced by the end user via a second 'clasp' unit. The second unit, designed with similar magnet connectors, could connect in series with the clasp-battery unit. The modifying circuit could modulate the light as described above, or modulate the light in response to some other stimuli such as, but not limited to, a solar sensor could be used to change the illumination level based on the ambient lighting; a sound sensor could modulate the illumination level based on ambient sounds; a 'mood' necklace could change illumination based on a temperature measurement made at the surface of the skin; and a wireless sensor could couple the necklace response to any number of wireless compatible devices such as cell phones etc.

The system may advantageously allow that jewelers or artisans with little or no knowledge of electricity can easily incorporate the clasp, power cell, and light source into their own work. The proper electrical connections are provided by the design of the magnetic clasp and power cell.

The various embodiments described above can be combined to provide further embodiments. All of the above U.S. patents, patent applications and publications referred to in this specification are incorporated herein by reference. Aspects can be modified, if necessary, to employ devices, features, and concepts of the various patents, applications and publications to provide yet further embodiments.

These and other changes can be made in light of the above detailed description. In general, in the following claims, the terms used should not be construed to limit the invention to the specific embodiments disclosed in the specification and the claims, but should be construed to include all types of dispensers, organizers and methods of making and installing the same that operate in accordance with the claims. Accordingly, the invention is not limited by the disclosure, but instead its scope is to be determined entirely by the following claims

The invention claimed is:

1. An illuminatable jewelry system comprising:

a length of electrically-conductive stringing material having a first end and a second end, and an illuminatable element comprising a light emitting diode disposed therebetween, the light emitting diode comprising a cathode side electrically connected to the first end of the electrically-conductive stringing material and an anode side electrically connected to the second end of the electrically-conductive stringing material;

a first magnetic connector having a first end and a second end, the first end of the first magnetic connector being electrically coupled to the first end of the electrically-conductive stringing material, and the second end of the first magnetic connector having a first magnetic polarity;

a second magnetic connector having a first end and a second end, the first end of the second magnetic connector being electrically coupled to the second end of the electrically-conductive stringing material, the second end of the magnetic connector having a second magnetic polarity, wherein the second magnetic polarity is the opposite of the first magnetic polarity; and

a power cell, the power cell comprising:

a negative terminal comprising a third magnetic connector having a first end and a second end, the first end of the third magnetic connector being electrically coupled to the negative terminal of the power cell, and the second end of the third magnetic connector having the second magnetic polarity; and

a positive terminal comprising a fourth magnetic connector having a first end and a second end, the first end of the fourth magnetic connector being electrically coupled to the positive terminal of the power cell, and the second end of the fourth magnetic connector having the first magnetic polarity;

wherein proper current flow from the power cell, through the length of electrically-conductive stringing material, and through the light emitting diode is automatically ensured when (i) the second end of the first magnetic connector is magnetically mounted to the second end of the third magnetic connector, and (ii) the second end of the second magnetic connector is magnetically mounted to the second end of the fourth magnetic connector.

2. The illuminatable jewelry system of claim **1**, further comprising decorative elements attached to the electrically-conductive stringing material, wherein the decorative elements do not emanate light.

3. The illuminatable jewelry system of claim **1**, wherein the power cell is replaceable with a different power cell to achieve different lighting effects.

4. The illuminatable jewelry system of claim **1**, wherein the illuminatable element comprises a glass capillary tube.

5. The illuminatable jewelry system of claim **1**, wherein the power cell includes a solar cell.

6. The illuminatable jewelry system of claim **5**, wherein the power is harvested from the solar cell using an energy harvesting circuit.

7. The illuminatable jewelry system of claim **1**, wherein the power cell includes a rechargeable battery.

8. An illuminatable jewelry system according to claim **1** wherein the power cell is removable from the illuminatable jewelry system, and the first and second magnetic connectors are coupleable to one another.

* * * * *